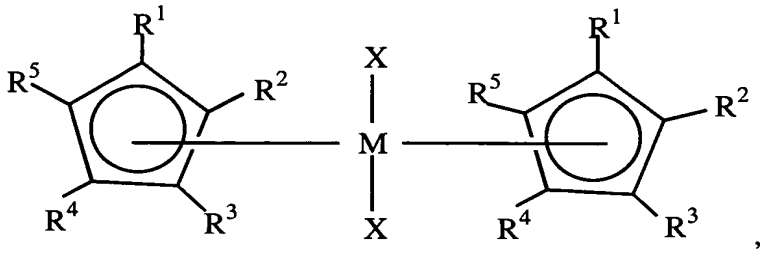
CLAIMS:

1. An opto-electroactive device comprising a metallocene of the formula



wherein M is zirconium or hafnium; X is halogen and R^1-R^5 are each independently hydrogen, aryl, alkyl, halogen or $-Si(R^6)_3$; or wherein at least two adjacent R substituents on at least one ring are joined to form a fused ring, which may be unsubstituted or substituted with aryl, alkyl, halogen or $-Si(R^6)_3$; or wherein the R^1 substituents on each ring are joined via a bridging ansa group, and

wherein R^6 is an alkyl group, a substituted alkyl group, an aryl group or a substituted aryl group.

2. The opto-electroactive device of claim 1, wherein X is fluoro, chloro or bromo, and R^1-R^5 are each hydrogen.

3. The opto-electroactive device of claim 1, wherein X is fluoro, chloro or bromo, and the R^1 substituents on each ring are joined to link the rings via a bridging ansa group, wherein the bridging ansa group is $-E(R^6)_2$ wherein E is carbon, silicon, or germanium, and R^6 is selected from the group consisting of alkyl, substituted alkyl, methyl, aryl and substituted aryl.

4. The opto-electroactive device of claim 3, wherein X is chloro and E is silicon.

5. The opto-electroactive device of claim 1, which comprises a zirconocene.

6. The opto-electroactive device of claim 5, wherein the zirconocene has a HOMO value of less than or equal to minus 6 electron volts.

7. The opto-electroactive device of claim 5, wherein the zirconocene is phosphorescent.

8. The opto-electroactive device of claim 1, which comprises a hafnocene.

9. The opto-electroactive device of claim 1, which is an electroluminescent device, an LED, an OLED, a photovoltaic device, a photoconductor, a photodetector, or in a chemical or biochemical sensor.

10. The opto-electroactive device of claim 1, wherein the metallocene is present in a light-emitting layer and the device emits light in the wavelength range of about 300 nm to about 1200 nm; or wherein the metallocene is present in a hole-blocking layer.

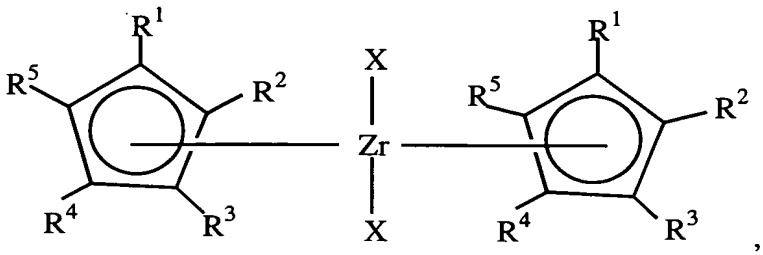
11. The opto-electroactive device of claim 1, wherein the metallocene is present in a light-absorbing layer and the device absorbs light in the wavelength range of about 300 nm to about 1200 nm.

12. The opto-electroactive device of claim 1, wherein the metallocene is present in the form of a composite comprising at least one metallocene and at least one polymeric or non-polymeric conductor.

13. The opto-electroactive device of claim 12, wherein the polymeric conductor comprises at least one of poly(9-vinylcarbazole) or poly(phenylsilane).

14. The opto-electroactive device of claim 12, wherein the non-polymeric conductor at least one of an aryl-substituted oxadiazole, an aryl-substituted phenanthroline, a benzoxazole, a benzthiazole, an aryl-substituted triazole, or 3-(4'-tert-butylphenyl)-4-phenyl-5-(4"-biphenyl)-1,2,4-triazole.

15. An opto-electroactive device comprising: (a) an anode; (b) a cathode; and (c) a layer comprising a zirconocene of the formula



wherein X is halogen and R^1-R^5 are each independently hydrogen, aryl, alkyl, halogen or $-Si(R^6)_3$; or wherein at least two adjacent R substituents on at least one ring are joined to form a fused ring, which may be unsubstituted or substituted with aryl, alkyl, halogen or $-Si(R^6)_3$ wherein R^6 is an alkyl group, a substituted alkyl group, an aryl group or a substituted aryl group; or wherein the R^1 substituents on each ring are joined to link the rings via a bridging ansa group; and

wherein the layer (c) is a light-emitting layer and the device emits light in the wavelength range of about 300 nm to about 1200 nm; or wherein the layer (c) is a light-absorbing layer and the device absorbs light in the wavelength range of about 300 nm to about 1200 nm; or wherein the layer (c) is a hole-blocking layer.

16. The opto-electroactive device of claim 15, wherein X is fluoro, chloro or bromo, and R^1-R^5 are each hydrogen.

17. The opto-electroactive device of claim 15, wherein X is fluoro, chloro or bromo, and the R^1 substituents on each ring are joined to link the rings via a bridging ansa group, wherein the bridging ansa group is $-Si(R^6)_2$ wherein R^6 is selected from the group consisting of alkyl, substituted alkyl, methyl, aryl and substituted aryl.

18. The opto-electroactive device of claim 15, which is an electroluminescent device, an LED, an OLED, a photovoltaic device, a photoconductor, a photodetector, or in a chemical or biochemical sensor.

19. The opto-electroactive device of claim 15, wherein the zirconocene is phosphorescent.

20. The opto-electroactive device of claim 15, wherein the zirconocene is present in the form of a composite comprising at least one zirconocene and at least one polymeric or non-polymeric conductor.

21. The opto-electroactive device of claim 20, wherein the polymeric conductor comprises at least one of poly(9-vinylcarbazole) or poly(phenylsilane).

22. The opto-electroactive device of claim 20, wherein the non-polymeric conductor comprises at least one of an aryl-substituted oxadiazole, an aryl-substituted phenanthroline, a benzoxazole, a benzthiazole, an aryl-substituted triazole, or 3-(4'-tert-butylphenyl)-4-phenyl-5-(4"-biphenyl)-1,2,4-triazole.

23. A method for making an opto-electroactive device comprising a zirconocene of claim 1, which comprises the step of applying the metallocene by vacuum deposition or from solution.

24. A method for making an opto-electroactive device comprising a zirconocene of claim 15, which comprises the step of applying the zirconocene by vacuum deposition or from solution.